STUDY ON THE DEVELOPMENT, PRODUCTIVITY AND PROFITABILITY OF ARIZONA AND BELLAROSA POTATO VARIETIES

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ABSTRACT

The potato (Solanum tuberosum) is a herbaceous plant that belongs to the nightshade family. They are edible, rich in starch so they are used in human nutrition in various forms, serve as animal feed, but can also be used as a raw material in various industries (Toader and Roman, 2014). Originally from South America, more precisely from the Andes Mountains region, potatoes are the 4th largest source of food energy after corn, rice and wheat (https://ro.wikipedia.org/wiki/Istoria_cartofului_%C3%AEn_imperiul_inca%C8%99). At maturity, the tubers have a dry matter composed of 70% starch, 2-4% cellulose, 2.5% pectins, 0.5-2% reducing carbohydrates and 0.5-1% sugars (Berindei, 1984). The objective was represented by the study of two potato varieties, namely Arizona (white potato) and Bellarosa (red potato) grown on two different plots analyzing both their productivity and profitability, both being two early varieties. The crops were studied during the entire vegetation period, also following the economic analysis and implicitly the profit of each variety. The first determination was related to planting density, respectively to the number of nests per hectare. All the technological works that were undertaken within the studied plots were noted, the vegetation phases from the moment of execution of each work with the help of the BBCH scale, the consumption of materials, time and fuel that each intervention involved. In the end, we also found out the costs of the works performed in order to be able to establish the profit obtained from the sale of each variety in order to be able to establish which of the two is more profitable. Prior to harvesting, two sets of samples representing 10 potato nests were extracted from the two plots in order to analyze the productivity of each variety. These determinations were performed under laboratory conditions and involved the following: number of tubers / nest, weight of tubers / nest (g), stem height

(cm), largest tuber / nest (g), smallest tuber / nest (g), their diameter in section (cm).

INTRODUCTION

Once introduced into the culture, the potato was more and more appreciated, mainly in the sub-Carpathian area, then in the hilly area, in the steppe and forest-steppe area, it spread much later. Regarding the area cultivated annually with potatoes, Romania ranks third in Europe (*Berindei, 2001*). The productions realized in Romania, as a unitary average, increased; for example, in 2009 the increase was about 1.15 t / ha compared to 1999 (*Berindei, 1995).* Although the area decreased slightly, overall, production remained constant. The average low production represents only 30% of that achieved in some Western European countries (*Toader and Roman, 2011*). Potato occupies, in terms of cultivated area and production, the 3rd place in our country for corn and wheat, respectively, in 2009 obtaining 186.5 kg of potatoes / inhabitant (*Bran, 2011*). The consumption of 89.3 kg of potatoes / inhabitant ranks Romania on the 7th place in Europe, after Poland, Greece, Malta, Ireland, Lithuania and Portugal; the limits were between 117.99 kg / place. (Poland) and 44.34 kg / place. (Italy) (*Plamădeală, 2008*). Going over these aspects, we must also discuss the ridiculous marketing prices of this crop by comparing them with the costs necessary for its establishment, maintenance and harvesting *(https://www.medlife.ro/articole-medicale/care-sunt-beneficiile-consumului-de-cartofi.html).*

MATERIAL AND METHOD

The monitoring and observations we made for the cultivation of potatoes in both cultivated varieties began with the work of planting the tubers that were previously sectioned (*Bularda, 2020*). Thus, for the establishment of the crop in the case of both varieties were used 57143 sectioned tubers, each with 2-3 meshes, with a planting rate of about 2 t / ha. The scheme according to which the planting was carried out was a traditional one for the potato culture, thus having a distance of 70 cm between rows / stalks, 25 cm between the tubers in a row, and their distribution was carried out at 10 cm in the soil. Shortly after planting, Sencor Liquid 600 SC (metribuzin 600 g / l) was applied twice. For the first application we used the dose of 0.9l / ha (pre-emergence), and for the second repetition 0.6l / ha (post-emergence), administering it about a month away from the first repetition. Potato cultivation in the case of both varieties benefited from 4 watering

whose irrigation norms were constant, namely 378 m^3 of water, the equivalent of 7 hours of watering. In order to maintain the crops at an optimal standard so that we can obtain a rich and qualitative harvest after the second applied irrigation, we intervened with the first treatment against manna (Phytophtora infestans), a pathogen very common and also very harmful in this case. The treatment was applied in 4 repetitions with a break period of about 7 days. The product used is Dithane 75 WG NEOTEC (75% mancozeb). Also, after the penultimate watering and the first application of the treatment against manna, the first spraying of the culture against the Colorado beetle took place, which settled in the studied culture in the second half of May. As in the case of manna, 4 treatments were required to remove pests from the culture consisting of the two cultivated potato varieties (Arizona and Bellarosa). The commercial product I used is Calypso 480 SC which has as active substance tiacloprid 480 g / l.

The aim of this study was to carry out a thorough analysis of cultivated potato varieties. Here we refer both to the cultivation technologies adopted for the establishment and maintenance of this crop consisting of white potato varieties-Arizona and red potato-Bellarosa, and to the financial part which is formed primarily by investment in this crop and secondly of the profit obtained after harvesting this plant. At the same time, we followed the productivity of the two varieties that are closely related to their profitability, so that we can conclude which of them is more profitable and more commercialized. In order to reach these results, we analyzed 10 samples of each variety, samples that were represented more precisely by 10 nests taken manually on the day of the beginning of the harvest. In order to reach these results, we analyzed 10 samples of each variety, samples that were represented analyzed. The first determinations were represented by the counting and weighing of all the tubers extracted from each nest, thus being able to establish the productivity of the two varieties related at least to the samples analyzed in this study. After finding the mass of all the tubers extracted from a nest, we individually determined the weight of the largest tuber, but also of the smallest to determine the limits of the weight range in which the sample is located. The average of the samples was calculated by summing all the values we determined, and the result obtained will be divided by the number of samples analyzed, namely 10. We found out the maximum value by comparing the values given by each sample and the highest of them will be selected. The same technique was used to establish the minimum value with the difference that following the comparisons the lowest value was

selected. To find out the coefficient of variation, we initially calculated

$$S = \sqrt{\frac{({x_1}^2 + {x_2}^2 + \cdots + {x_n}^2) - \frac{(x_1 + x_2 + \ldots + x_n)^2}{\mathrm{n}}}{n-1}} \quad (1)$$

the value of the standard deviation (S) based on the following formula: where x=test and n=sample number.
Subsequently, the coefficient of variation (CV) was calculated

$$CV = \frac{s}{\bar{X}} \times 100 \quad (2)$$

according to the formula:
where S=standard deviation; $\bar{X}$=average of samples (*http://www.phys.ubbcluj.ro/~dana.maniu/BIOSTAT/C2.pdf*).

Table 1

Technology sheet

No.	Executed work	Diesel consumption l/ha	Material consumption / culture	No of people	Expenses / ha
1	Plowing	18L		1	Diesel 81 RON
2	Apply poultry manure	30L	Poultry manure 2.5t	6	25t-1800 RON 5 laborers - 500 RON Diesel- 135 RON **TOTAL- 2435 RON**
3	Milling	35L		1	Diesel- 157,5 RON
4	Tubercules sectioning			4	4 laborers - 400 RON
5	Planting	15L	1.5t/ha Arizona/Bellarosa tubercules sectioning	5	Seed material Arizona-2850 RON Bellarosa seed material -3150 RON 4 laborers- 400 RON Diesel - 67,5RON **TOTAL Arizona-3317,5 RON** **TOTAL Bellarosa-3617,5 RON**
6	Spraying herbicide	8L	Sencor Liquid 600 SC 0,9l/ha-preemergent 0,6l/ha-postemergent TOTAL- 1,5l	1	Sencor Liquid 600 SC 1,5l-270 RON Diesel -36 RON **TOTAL-306 RON**
7	Rebilonat	6L		1	Diesel -27 RON

No.	Executed work	Diesel consumption l/ha	Material consumption / culture	No of people	Expenses / ha
8	Transport of irrigation system and motor for water pumping	1.5L		1	6,75*4 watering -27 RON Diesel -27 RON **TOTAL- 54 RON**
9	Irrigation	10.5L/watering =42L/ season	Water from wells drilled at a depth of 20 m	2	Diesel -189 RON
10	Apply treatment against rain	4L	Dithane fungicide M 45 2,5kg/ha-10kg/ha/season	1	Dithane fungicide M 45 10kg-450 RON Diesel -18 RON **TOTAL-468 RON**
11	Application of treatment for pests	4L	Calypso 480 SC 0,08l/ha-0,32l/ha/season	1	Calypso 480 SC 40 ml-55 RON Diesel -18 RON **TOTAL-73 RON**
12	Application foliar fertilizer	4L	Folimax 4l/ha	1	Folimax 4l-120 RON Diesel -18 RON **TOTAL-138 RON**
13	Harvest	50L		8	7 laborers – 700 RON 5 harvest days with 7 laborers per day 700*5=3500 RON Diesel -225 RON **TOTAL-3725 RON**
TOTAL EXPENDITURE / CULTURE					Arizona-11.371 RON
					Bellarosa- 11.671 RON

RESULTS AND DISCUSSIONS

Table 2

Determination of productivity elements – Arizona variety, sample 1

No.	Number of nests / ha	No. Tubercules / nest	Weight of tubercules / nest (g)	Largest tubercules / nest (g)	Smallest tubercules / nest (g)
1.		9	1360	253	79
2.		12	1713	202	84
3.		8	1254	214	81
4.		10	1402	268	85

5.	57142	8	1311	227	73
6.		9	1276	195	82
7.		9	1356	243	80
8.		11	1407	252	79
9.		9	1222	241	86
10.		8	1317	238	84
Average	57142	**9,3**	**1361,8**	**233,3**	**81,3**
P_{max}	-	12	1713	268	86
P_{min}	-	8	1222	195	73

Table 3

Determination of productivity elements - Bellarosa variety, sample 2

No.	Number of nests / ha	No. tubercules / nest	Weight of tubercules / nest (g)	The largest tubercules / nest (g)	Smallest tubercules / nest (g)
1.	57142	8	970	166	76
2.		11	1139	189	81
3.		7	889	167	75
4.		7	952	160	79
5.		9	1012	172	75
6.		8	967	161	77
7.		7	901	154	73
8.		11	1098	169	83
9.		9	967	157	74
10.		10	1012	164	82
Medie	57142	**8,7**	**990,7**	**165,9**	**77,5**
P_{max}	-	11	1139	189	83
P_{min}	-	7	889	154	73

Production calculated for the Arizona variety according to the samples analyzed without loss: Weight of tubers / nest * Number of plants / hectare = Production of Arizona variety / hectare →1361.8 * 57142 = 77.08 tons.

Production calculated for the Bellarosa variety according to the samples analyzed without loss: Weight of tubers / nest * Number of plants / hectare = Production of Bellarosa variety / hectare →990.7 * 57142 = 56.61 tons. Thus, based on these calculations we can observe the estimated yields obtained from the two cultivated varieties, Arizona and Bellarosa. From the calculated production of 77.08 tons for the Arizona variety, only 56.2 tons were obtained, so a difference of 20.88 tons, while for the Bellarosa variety there were 32.7 compared to 56.61 tons. as we calculated in advance, ie a difference of 23.91 tons. Following the calculations, there was a considerable

discrepancy between the productivity potential of Arizona and Bellarosa varieties, this gap being favorable for white potatoes which would bring a production surplus of 20.47 tons.

In fact, taking into account the losses recorded, the difference in production between the two varieties grown on the farm, at least in the year of the study, is 23.5 tones.

These differences occur due to several reasons such as:

- First, the amount of the final harvest was diminished due to the well-known pathogen Synchytrium endobioticum.
- Secondly, the decrease in the calculated production can also be attributed to the seed material used for the establishment of crops, because during the study we noticed that the density of the field was not exactly 100%, the discordant note being made by some nests that had been left behind in the process of growth and development.
- From the poorly developed nests we obtained a number of tubers located below the average of the determined samples, but also the dimensions of the potatoes were in accordance with their number and the degree of development of the plants.
- Thirdly, the differences between the productivity potential of the two varieties and the productions obtained in the study can also be attributed to the phenomenon of acclimatization of the seed material used.
- Lastly, the discrepancies noticed following the calculations made to find out the potato productions may be due to the fact that the used soils are exploited for successive crops, after the harvest of potatoes follows the establishment of cabbage, which shortens the vegetation period of the studied crop. So that the next crop can grow in optimal conditions and can also be marketed at a suitable time. Thus, potatoes are harvested earlier than the optimum period, which is a plus by the fact that it can go on the market earlier, but this is also a disadvantage because many tubers do not reach the maximum potential for development which negatively influences the amount of final production.

Although between the productions of the two varieties we have an unfavorable difference of 23.5 tons for red potatoes (Bellarosa), after establishing the coefficients of variation for each element of productivity it can be noticed that the production of 32.07 tons of Bellarosa variety is more stable.

Table 4

Values of the variation coefficient

Productivity elements	Plot cultivated with the Arizona variety	Plot cultivated with the Bellarosa variety
No. tubercules / nest	14,38	18,60
Weight of tubercules / nest (g)	10,96	7,95
The largest tubercules / nest (g)	10,07	5,90
Smallest tubercules / nest (g)	4,71	4,56

According to the table 4 it can be seen that only for the number of tubers / nest the value of the coefficient of variation is increased by 4.22% for the Bellarosa variety, and for the rest of the productivity elements we have lower values than the homologous variety by 3.01% for the weight of the tubers / nest, 4.17% for the largest tuber / nest and 0.15% for the smallest tuber / nest.

Analysis of the economic results of the studied potato varieties

We can see that for the Arizona variety the purchase price of the seed was 1.9 RON / kg, and for the Bellarosa variety 2.1 RON / kg was paid. So we have a difference of 0.2 bani / kg which translates into an inequality of 300 RON per hectare (3150 RON-2850 RON = 300 RON / ha for 1.5 t / ha of seed material).

As we calculated at the end of table 1, the total investment for the Arizona potato variety reached 11,371 RON, and the Bellarosa potato variety required an investment of 11,671. It can be noticed that the difference of 300 RON that was registered when purchasing the seed material was maintained. Thus, multiplying the production obtained with the price per ton in the case of each variety, we will find out the revenues for each hectare, and we will find out the profit as well.

As I mentioned, the sale was wholesale at the price of 1200 RON per ton for white potatoes, Arizona variety and 1500 RON for red potatoes, Bellarosa variety.

Proceeds for the Arizona variety: Total production * Sales price / tons = Receipts →56.2 * 1200 = 67440 RON.

Proceeds for the Bellarosa variety: Total production * Sales price / tons = Receipts →32.7 * 1500 = 49050 RON.

Knowing the revenues obtained from the sale of the potato crop for both the Arizona variety and Bellarosa, we can determine the profit obtained from this crop. This will result in a decrease in total revenue.

Ariziona variety profit: Revenues- Investment = Profit →67.440-11.369 = 56.071 RON

Bellarosa variety profit: Revenues - Investment = Profit →49,050-11,671 = 37,379 RON

Following the analysis of the economic results for the two cultivated and analyzed varieties, we find that the Arizona variety brings a profit of 56,071 RON, and the Bellarosa variety of 37,379 RON, so a difference of 18,692 RON.

In conclusion, the Arizona variety is superior to the Bellarosa variety both in terms of productivity and in terms of profitability. Although the marketing price for white potatoes belonging to the studied variety is lower, this is offset by the purchase price of the seed which is lower, but also by their productivity which is clearly higher than the Bellarosa variety

CONCLUSIONS

The cultivation technologies approached in the study are identical for both varieties analyzed, leading to a total investment slightly different from each other depending on the purchase price of the seed material, which is also influenced by the variety chosen (Arizona variety investment). - 11,369 RON, and purchase price of the seed material - 1.9 RON / kg; investment of the Bellarosa variety - 11,671 RON, and purchase price of the seed material - 2.1 RON / kg). The noticeable difference between the production potential and the real production of each variety can be attributed to several factors such as: pathogens, seed material quality, acclimatization phenomenon and early harvest. The analysis of the two varieties placed on the first place in terms of productivity the white potatoes belonging to the Arizona variety. Their capitalization was carried out at an optimal price, to which is added their productivity which made the revenues from them to be significantly higher than those obtained from the Bellarosa variety. Although the applied cultivation technologies were identical for both potato varieties analyzed following the study on the productivity elements, all average values of the productivity elements are higher for the Arizona variety, as a result the real production is increased (23.5 tons), which in the result of capitalization brings an additional revenue of 18,692 RON. The Arizona and Bellarosa varieties showed a development of the elements of productivity and profitability in accordance with the cultivation technology and the time of harvest. Thus, it can be appreciated that both varieties of potatoes are very profitable and respond very well to the applied technologies, as evidenced by increased yields if they benefit from all the conditions for optimal growth and development.

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